FASTENING ARRANGEMENT, FOR A SAFETY BELT BUCKLE, EQUIPPED FOR MEASURING BELT FORCE

Description

The invention relates to a fastening arrangement for a safety belt, comprising a holder that is to be secured to a vehicle, and a connector that is moveably disposed, against spring action, on the holder, and is connected to a belt buckle or a belt strap loop, whereby a magnet and a magnetic field sensor are disposed on the holder and connector, and the relative movement between magnet and magnetic field sensor caused by displacement of the connector relative to the holder, which displacement is effected by the tension acting on the belt buckle, is converted into a signal that corresponds to the acting belt force.

A fastening arrangement having the aforementioned features and provided for a belt buckle is described in WO 01/79039 A1; such a fastening arrangement for a safety belt buckle, and provided with a sensor arrangement, serves for determining the belt force that respectively occurs in the safety belt system under various stress conditions, in order as a function of the measured belt force to control further components of the safety system, such as, for example, airbag devices.

With the known fastening arrangement, formed in the holder that is secured on the vehicle side is a region within which is moveably disposed a carriage that is guided on the holder; at least one compression spring disposed between holder and carriage tensions the carriage relative to the holder and enables a displacement of the carriage in the holder portion in conformity with the spring path. The connector that is connected with the belt buckle is embodied as a loop that extends through the portion of the holder and thereby spans the outer contour of the carriage that is moveable in the holder portion in such a way that a tension force that acts upon the connector brings about a displacement of the carriage in the portion of the holder against the force of the compression spring. Mounted on the holder and carriage, in a cooperative association, are a magnet and a magnetic field sensor, so that the relative movement of carriage and holder to one another in conformity with the respectively occurring belt force is to be detected via the change of the magnetic field that is received by the magnetic field sensor, and is capable of being converted in a microprocessor into a suitable signal for the control of further components of the vehicle safety system.

The known fastening arrangement has the drawback of a complicated construction and a cumbersome assembly. For example, the holder, and the carriage that is moveably guided therein, must be produced with the necessary precision and must be assembled together with the springs, whereby the assembly or mounting of the carriage on the holder is cumbersome due to the compression springs that are disposed within the portion of the holder. The connector, with its loop, must then be guided through the recess of the holder in a further assembly step, and in so doing must be oriented relative to the carriage, whereby the loop must again be reliably closed at the conclusion of the assembly.

It is therefore an object of the invention to simplify the construction and assembly of a fastening arrangement having the aforementioned features.

The solution of this object, together with advantageous embodiments and further developments, can be gleaned from the content of the patent claims that follow this description.

The basic concept of the invention is that the holder is provided with a T-shaped head having arms that extend laterally relative to its

longitudinal axis, and the connector is provided with abutments positioned opposite the arms of the holder, and that on the outer longitudinal sides of head and connector, the holder is provided with a T-shaped head having arms that extend laterally to its longitudinal axis and the connector has abutments positioned opposite the arms of the holder, and that on the outer longitudinal sides of head and connector, at least one spring is provided that is disposed between the arm of the holder and the abutment of the connector, and the spring counteracts a tension force of the safety belt.

A buckle holder having a T-shaped head is known from DE 196 54 277 A1, although no belt force measurement is provided.

The invention has the advantage that it is possible to eliminate the separate carriage provided in the state of the art because holder and connector are mounted directly on one another. The particularly selected arrangement of the springs on the outer longitudinal sides of holder and connector insures a good accessibility during assembly of the fastening arrangement and during insertion of the springs between connector and holder, so that the assembly of the fastening arrangement is considerably simplified. The springs arranged on the outside additionally prevent a lateral deflection of connector and holder

relative to one another, so that the precision of measurement of the sensor arrangement disposed between holder and connector is improved.

One embodiment of the invention provides that the connector comprises two plates that are parallel to one another and enclose or encase between them the T-shaped head of the holder, including the arms thereof, and the abutments formed on the connector for the springs are formed by connecting flanges disposed perpendicular to the plane of the plates. This ensures a good guidance of the connector during its displacement relative to the holder.

One embodiment of the invention proposes the use of compression springs as springs disposed between the arm of the holder and the abutment; this offers the advantage that in extreme load conditions, for example during a crash, the compression springs are pulled as a unit and thus large forces can also be transferred without destroying the compression springs.

Pursuant to an embodiment of the invention, the connector is provided with an abutment surface against which is supported the T-piece of the holder that is loaded by the compression springs.

To facilitate assembly and improve the spring effect, pursuant to one embodiment of the invention there are formed on the arms of the T-shaped head, and on the abutments of the connector, guide members that project in the direction of extension of the compression springs.

Pursuant to embodiments of the invention, the connector can be connected via a connecting means with the buckle housing, or the connector can be a monolithic component of the buckle housing.

To the extent that a monolithic embodiment of buckle housing and connector is provided, one embodiment of the invention provides that the buckle housing, which is embodied in a U-shaped manner with a base plate and laterally raised U-legs, for the embodiment of the one-piece connector, is provided with an axial extension portion of its base plate, on the ends of which are formed the abutments accompanied by the formation of a space relative to the U-legs. This not only has the advantage of a reduction of the overall size of the buckle housing with connector, but rather also the number of individual components is reduced, so that a correspondingly low assembly expenditure and effort result. In this connection, it can be provided that the arms of the holder, including the arrangement of the springs, be disposed in the

space, whereby the holder is secured on the base plate of the buckle housing so as to be relatively moveable to it.

As can be gathered in principle from the prior art document, the holder can be embodied as a rigid component or as a flexible cable holder. The flexible cable holder offers the advantage of a significantly higher precision of measurement; this is achieved in that the belt buckle can respectively be adapted to the direction of the belt application.

The direct coupling of connector and holder makes it possible, pursuant to an embodiment of the invention, to select a sensor arrangement where the magnet comprises a bar magnet that is oriented in the longitudinal direction of holder and connector, and is mounted on the inner side of the connector that faces the T-shaped head of the holder, and the longitudinal axis of the magnetic field sensor is mounted at a right angle to the longitudinal axis of the bar magnet and within the magnetic field thereof on the head of the holder, whereby it can be provided that the bar magnet be mounted on the one plate of the connector, and that on the other plate there be formed a portion or cutout that spans the magnetic field sensor.

In an alternative embodiment, a formation of the sensor arrangement is provided where the magnet comprises a bar magnet that is oriented in the longitudinal direction of holder and connector, and is rotatably mounted on the connector, and on the connector is disposed the magnetic field sensor that detects the change in position of the bar magnet, and that during its displacement relative to the connector, the holder deflects the bar magnet out of its orientation in the longitudinal axis of the connector, whereby it can be provided that the head of the holder engage via an articulated lever arm against the bar magnet that is rotatably mounted on the connector. However, alternatively the head of the holder can also act directly upon the rotatably mounted bar magnet.

In particular the one-piece embodiment of buckle housing and connector provides the possibility of also embodying the arrangement of the magnet as well as of the magnetic field sensor in a simple form, and it is thus provided pursuant to an embodiment of the invention that the magnetic sensor be mounted on the holder, and the magnet be embodied in the form of a bridge that spans the base plate of the buckle housing and is fixed in position on the lateral U-legs of the buckle housing, and be disposed in such a way that the magnetic field sensor be disposed below the magnet bridge. In this connection, it can

be expedient for the magnetic field sensor to be secured on the holder via a sealing compound that encloses it.

For a use within the framework of the invention conventional magnetic field sensors are suitable that are described in the data sheets "KMZ41 Magnetic Field Sensor" of 18 April 2000 or "UZZ9000 Sensor Conditioning Electronic" of 27 November 2000 of the Philips Semiconductors Company.

The provision of the relative movement between holder and buckle housing, accompanied by the interposition of the springs, can in individual cases lead to the formation of a tolerance chain having a correspondingly high tolerance window, which on the one hand can cause noise problems due to rattling of the components, and on the other hand can also cause a delayed response of the measuring arrangement. Pursuant to one embodiment of the invention, this is to be counteracted, for example, in that the measuring forces, with appropriate design of the measuring springs in the longitudinal direction, are to be applied centrally on the measuring springs so that the measuring springs continue to be provided with a pre-stress; however, despite the pre-stress, during introduction of a belt force

there would already result a change in path of the magnetic field sensor relative to the magnet.

A proposal that is structurally easy to realize for overcoming the aforementioned problem comprises, pursuant to an embodiment of the invention, disposing between holder and buckle housing a compensation spring that is respectively supported on holder and buckle housing and that, without a tension force acting on the buckle housing, pre-stresses the buckle housing relative to the holder against the nearly relaxed spring with a spring force that is set low. In so doing, pursuant to an embodiment of the invention the compensation spring can be embodied as a pre-bent flat spring that via a central portion is fixed in position on the buckle housing, with its lateral outer ends acting upon the holder with pre-stress and, when a relative displacement of the buckle housing with connector relative to the holder is effected, coming free from the holder due to the tension force that engages the buckle housing. Thus, a floating system is made available according to which with every change in force a path change also results, so that it is advantageously possible to also detect via a measuring technique a region of low force acting upon the buckle housing.

The invention is not limited to the arrangement at a belt buckle, but rather also covers embodiments where the belt force measurement is provided at an end fitting for the safety belt. In this case, a belt loop engages directly at the connector, so that the tension force that is exerted upon the safety belt acts directly upon the connector. Furthermore, where the fastening arrangement is embodied as an end fitting, the holder can have a two-part configuration, including a holding portion that is to be secured to the vehicle, and a fitting portion that is provided with the lateral arms and to this extent cooperates with the connector. This provides the possibility of adapting the holding portion to the respective installation position of the end fitting in the vehicle, without this affecting the measurement arrangement.

Exemplary embodiments of the invention are provided in the drawings and are described in the following. Shown are:

Fig. 1 an overall illustration of a belt buckle having a fastening arrangement,

Fig. 2 the fastening arrangement for holding the buckle housing in a detailed illustration and in a partially assembled state without the sensor arrangement,

Fig.2a an enlarged schematic illustrationof the detail "X" in Fig. 2

Fig. 3 the subject matter of Figure 2 in the final assembled state, including the sensor arrangement,

Figs.3a, 3b the association of bar magnet and magnetic field sensor in a detailed illustration,

Fig. 4 another embodiment of the fastening arrangement of Fig. 3,

Fig. 4a an enlarged detailed illustration of the support of the bar magnet of Fig. 4,

Fig. 5 another embodiment of the subject matter of Figure 2,

Fig. 6 a detailed illustration of the buckle housing including connector pursuant to Figure 5,

Fig. 7 the subject matter of Fig. 6 with the connection of the holder without integration of the measurement arrangement,

Fig. 8 an enlarged illustration of the arrangement of an additional compensation spring with the subject matter of Figure 7, with the belt buckle in a non-loaded state,

Fig. 9 the subject matter of Figure 8 with the belt buckle subjected to tension force,

Fig. 10 an overall view of an embodiment of the fastening arrangement in an embodiment as an end fitting for the holding of the safety belt,

Fig. 11 the subject matter of Figure 10 with the housing caps removed,

Fig. 12 a detailed illustration of the holder of Figure 11.

As can be seen initially from Figure 1, the fastening arrangement for a safety belt lock or buckle 12 comprises a holder 10 that is to be secured to a vehicle, whereby the belt buckle 12 is fixed in position on the holder 10 via a connector 11 in a manner that will be described in detail subsequently. Substituent of the belt buckle 12 is a tongue 13.

As can be seen in greater detail from Figure 2, the buckle housing 14 is connected via a connecting rivet or pin 15 with an extension of the connector 11. The holder 10 has a T-shaped head 16 with arms 17 that extend laterally relative to its longitudinal axis. The head 16 of the holder is encased by the connector 11, which is comprised of two plates 18, thus ensuring an adequate guidance of the connector 11 on the holder 10. The two plates 18 are interconnected by connecting elements or flanges 19 that are disposed perpendicular to their plane, whereby the connecting flanges act as abutments, which are positioned opposite the lateral arms 17 of the holder 10, with the arrangement of compression springs 21 that are disposed at the outer longitudinal sides of the head 16 and the connector 11, with as great a

spacing as possible to their aligned longitudinal axis. To facilitate the mounting of the compression springs 21, and for their guidance, formed on the lateral arms 17, as well as on the connecting flanges 19, are guide members 20 that respectively project in the longitudinal direction of the compression springs 21.

As can be seen from the schematic illustration of Figure 2a, the connector 11 is provided with a contact or bearing surface 11a that is formed by a bend and against which the T-shaped head 16 of the holder 10 is supported due to its pre-stress by the compression springs 21 in the direction of the buckle housing 14. To the extent that instead of the compression spring 21 the use of a tension spring is also conceivable, the bearing surface must be appropriately formed on the holder 10.

As can be seen in detail in Fig. 3, the T-shaped head 16 of the holder 10 is fixedly connected with a carrier element 33 on which a bar magnet 23 is fixedly disposed via a holding device 24. Disposed on the upper plate 18 of the connector 11 is a carrier plate 27 for a magnetic field sensor 28; the carrier plate 27 is connected with the plate 18 via securement elements 29, and is connected via a connecting cable 26 to a control device, on the vehicle side, or further

components of the safety system. It is also possible to dispose on the carrier plate 27 further elements 25 via which, for example, a measurement signal can be further processed, or various transfer protocols are made possible.

As can furthermore be seen from Fig. 3 in conjunction with Fig. 3b, the longitudinal axis of the magnetic field sensor 28 is oriented at right angles to the longitudinal axis of the bar magnet 23, so that a change in position of the bar magnet 23 leads to a rotation of the magnetic field relative to the magnetic field sensor 28, which is deleted or received by the magnetic field sensor 28.

Particularly advantageous for the arrangement of bar magnet 23 and magnetic field sensor 28 is, pursuant to Fig. 3a, a bar magnet 23 that is comprised of two oppositely polarized magnets 23a and 23b. The shifting of the magnetic field sensor 28 in the longitudinal direction R relative to the bar magnets 23, and at right angles to the directions of magnetization, effects a correspondingly large change in direction of the magnetic field that acts upon the magnetic field sensor 28.

An arrangement comparable to the previously described embodiment results from the embodiment illustrated in Figures 4 and 4a, according

to which the bar magnet 23, via a rotary support 31, is rotatably disposed on the upper plate 18 of the connector 11. Fixedly disposed on the bar magnets 23 is a lever arm 34, with its longitudinal axis extending at right angles to the direction of movement of the T-shaped head 16 of the holder 10 relative to the connector 11.

In the same manner as with the embodiment described in conjunction with Fig. 3, a magnetic field sensor 28 having carrier plate 27 and connecting cable 26 is associated with the rotatably mounted bar magnets 23; the carrier plate is again secured to the upper plate 18 of the connector 11. In the same way further elements 25 can also be disposed on the carrier plate 27, as mentioned above.

A carrier element 33 is fixedly connected with the T-shaped head 16 of the holder 10, whereby the carrier element 33, via a rotatable support 35, is coupled with the end of the lever arm 34 in such a way that a displacement of the connector 11 relative to the holder 10 leads to a pivoting of the rotatably mounted bar magnet 23 out of its alignment in the longitudinal axis of the holder 10, whereby this change in position of the bar magnet 23 in turn effects a rotation of the magnetic field, which is received by the magnetic field sensor 28.

The embodiment illustrated in Figures 5 to 7 shows a buckle housing 14 that is monolithically formed with the connector 11 and which is embodied in a U-shaped manner with a base plate 40 and U-legs 41 that project laterally up therefrom. The buckle housing 14 is provided, in an extension of the base plate 40, with an extension portion 42, on the ends of which, accompanied by the formation of a space 43, are formed the abutments 19 for the placement of the compression springs 21, whereby the abutments 19, in turn, are provided with guide members 20. As can be seen in particular from Figure 7, the holder 10, with its T-shaped head 16 and the laterally extending arms 17, is inserted into the extension portion 42 of the buckle housing 14 in such a way that the lateral arms 17, including the compression springs 21 that are disposed between the lateral arms 17 and the abutments 19, are disposed in the space 43. With this embodiment, the measuring arrangement is such, as can be seen from Figure 5, that the magnetic field sensor, which is not recognizable in detail in Figure 5, is mounted on the holder 10, for example by securement via a sealing compound, which has the advantage that the connecting cable is not subjected to any movement since the holder 10 is stationary. In this case, the magnet that is associated with the magnetic field sensor is embodied as a magnet bridge that spans the extension portion 42 and hence the securement of the holder 10 thereon; the magnet bridge is adapted to

be positively fixed in position in the lateral U-legs 41. This provides a particularly straightforward manner of construction.

To suppress the influence of possible tolerances, with the embodiment illustrated in Figures 8 and 9 there is disposed in addition between the holder 10 and the buckle housing 14 a compensation spring 50 that is embodied as a curved, pre-bent flat spring; the central region 51 of this curved flat spring is fixed in position on the base plate 40 of the buckle housing 14, whereby the lateral, outer ends 52 of the flat spring, when the belt buckle or buckle housing 14 is in a non-loaded state, are supported against the ends of the holder 10 and in so doing press the holder 10 with a force that has been set low against the nearly relaxed compression springs, which act as measurement springs (Figure 8). If under load there is effected a displacement of the buckle housing 14 relative to the stationary holder 10, the compression springs 21 are tensioned; at the same time, the outer ends 52 of the compensation spring 50 are freed from the holder 10, so that the correspondingly exerted tensioning force is released and the detection of the relative displacement of buckle housing 14 to holder 10 via the measuring arrangement is not affected.

Finally, Figures 10 to 12 illustrate an embodiment of the invention according to which the fastening arrangement is embodied as an end fitting for holding a safety belt, as can be seen in Figure 10. In so doing, the measuring arrangement between the holder 10 and the connector 11, to which a belt loop 60 is attached, is covered by housing caps 61.

As can be seen from Figure 11, the measuring arrangement, with magnet and magnetic field sensor, is unchanged, for example, relative to the embodiment described in conjunction with Figures 5 to 7, with the difference that the belt strap loop 60 is attached directly to the connector 11, so that the tension load that acts on the safety belt acts directly on the connector 11 and effects its relative displacement relative to the stationary holder 10.

As can be seen as a complement thereto from Figure 12, the holder 10 can comprise a holding portion 10a, which is to be secured to the vehicle, and a separate fitting portion 10b, whereby formed on the fitting portion 10b are the lateral arms 17 which are engaged by the springs 21 and that cooperate with the connector 11. The two-part embodiment of the holder provides a greater freedom of construction

with regard to the securement of the holder 10 in specific installed positions in a vehicle.

The features of the subject matter of this document disclosed in the preceding specification, the patent claims, the abstract and the drawing can be important not only individually but also in any desired combinations with one another for realizing the various embodiments of the invention.